

**Questions and Answers about EMF****Electric and Magnetic Fields Associated with the Use of Electric Power**

## **Biological Studies**

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**Q.** What effects of EMFs have been reported in laboratory studies?

**A.** Several kinds of biological effects have been reported in studies of electric and /or magnetic fields (see below). A biological effect is a measurable change in some biological factor. It may or may not have any bearing on health. Overall, effects attributed to EMFs have been small and difficult to reproduce. Very specific laboratory conditions are usually needed for effects of EMFs to be detected. It is not known how EMFs actually cause these effects.

Laboratory studies to date have not answered questions about possible human health effects. These studies are, however, providing clues about how EMFs interact with basic biological processes. The cell membrane may be an important site of interaction with induced currents from EMFs.

Keep in mind that some of these effects are within the "normal" range of variation. A biological response to a particular stimulus does not necessarily result in a negative health effect.

**Q.** What about effects of EMFs on the hormone melatonin?

**A.** Melatonin is a hormone produced mainly at night by the pineal, a small gland in the brain. One reason scientists are interested in melatonin is that it could help explain results of some EMF epidemiological studies. Melatonin has been reported to slow the growth of some cancer cells, including breast cancer cells, in laboratory experiments. If powerfrequency EMF can affect melatonin in humans, this could be a mechanism to explain results of some EMF studies of breast cancer.

In the 1980s, scientists found that in rats exposed to 60-Hz electric fields, nighttime melatonin levels were reduced. Other studies have since reported that both AC and DC magnetic fields can also affect melatonin levels in rats and hamsters. These experiments are very delicate and depend on a combination of factors such as age of the animals and length of day. Melatonin levels were not affected in sheep raised for nearly a year in the EMFs directly beneath a 500-kV transmission line. Experiments with baboons also showed no changes in melatonin. The Midwest Research Institute (MRI) has studied the effect of 60-Hz magnetic field exposure on human melatonin. In 1993 MRI reported that although subjects showed no effect on the average, those individuals with naturally lower levels of melatonin did show a small further decrease. However, in 1994 MRI reported that a second study, specifically designed to replicate the earlier results, found no such effect.

### **On to Government Actions...**

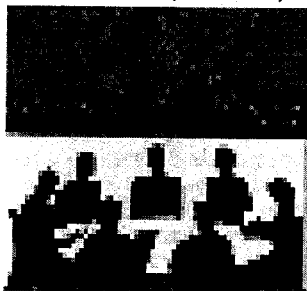
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## Government Actions

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**Q.** What have governmental reviews concluded about EMFs and cancer?

**A.** Most recent reviews have concluded that the existing evidence, although suggestive, does not show that EMFs cause cancer. These include national reviews by the U.S. Environmental Protection Agency, the Committee on Interagency Radiation Research and Policy Coordination, the Australian Minister of Health, the National Radiological Protection Board of the United Kingdom, the Danish Ministry of Health, the French National Institute of Health and Medical Research, and reviews sponsored by the states of California, Texas, Connecticut, Illinois, Maryland, and Colorado.



The Swedish government issued a public information document in May 1994 that states, "We suspect that magnetic fields may pose certain risks to health, but we cannot be certain." While research is under way to pin this down, the report continues, "there is good reason to exercise a certain amount of caution." The Swedish government recommends against locating new homes and schools near existing electricity generating plants and proposes that high magnetic fields in homes, schools, and workplaces be limited. It specifically states, however, that "current knowledge is not sufficient for us to tell how magnetic fields affect us. So we do not have a basis on which to set [exposure] limits."

In nearby Denmark, a government agency concluded there was no scientific reason to establish magnetic field standards for high-current lines.

### Some Quotes from National EMF Reviews

"Some of the epidemiological evidence is suggestive of an association between surrogate measurements of magnetic-field exposure and certain cancer outcomes . . . [lack of sufficient data] prevents the inference of cancer causality from these associations at this time."

—U.S. EPA Science Advisory Board 1991

"It has not been scientifically established that magnetic fields of extremely low frequency initiate or promote cancer or have any other harmful effects on humans. However, it has not been scientifically established that

"The Danish and Swedish study supports the hypothesis of previous studies that children living near high-current plants have an increased frequency of cancer. But the results do not exclude the possibility that the association might be due to chance."

—Danish Ministry of Health 1993

"The epidemiologic results presently available do not permit the exclusion of a role for magnetic fields in the incidence of leukemia, particularly in children. New investigations are necessary to confirm or deny this role."

such fields are not harmful."

*-Advisory Panel to Australian Minister  
of Health 1992*

*-French National Institute of Health and  
Medical Research 1993*

"The epidemiologic findings that have been reviewed provide no firm evidence of the existence of a carcinogenic hazard from exposure [to EMFs] ... the findings to date can be regarded only as sufficient to justify formulating a hypothesis for testing by further investigations."

*-U.K. National Radiological  
Protection Board 1992*

"We suspect that magnetic fields may pose certain risks to health, but we cannot be certain ... There is good reason to exercise a certain amount of caution."

*-Swedish National Electrical  
Safety Board 1994*

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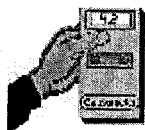
## Your EMF Environment

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**Q.** What are some typical EMF exposures?

**A.** First, "exposure" must be defined. Scientists are still uncertain about the best way to do this, because experiments have shown that several aspects of the fields may be relevant to biological effects. Should exposure be an average of changing magnetic field levels over some time period, or should it focus only on time spent in high fields above some threshold value? Are rapid field changes important? Does the frequency content play a role? Even though the average field level has been used widely to represent EMF exposure, it is possible that other definitions may relate more closely to any possible effects.

Second, EMF in the environment is very complicated. We are usually exposed to EMF from a large number of sources every day. Fields change both in time and space. A person's EMF exposure depends to a large degree on what he or she is doing in the field at the time.



Several kinds of small meters are now available that can be carried or worn by a person to record magnetic field exposures automatically. The figure on the next page is an example of data collected with one of these meters. The magnetic field was measured every 24 seconds over a 24-hour period. For this person, field exposure at home was very low. The occasional spikes (short exposures to high fields) occurred when the person drove or walked under or over power lines or was close to appliances in the home or office.

Some studies have used these automatic gaussmeters to measure human exposure to magnetic fields (see above). These studies tend to show that appliances and building wiring contribute to the low-level background magnetic field exposure that most people receive. People living close to large power lines tend to have higher overall field exposures. However, as shown on the chart below, there is much individual variation among homes.

**Q.** How do electric and magnetic fields from transmission lines and appliances compare?

**A.** Electric fields close to transmission lines are much stronger than the fields found near electrical appliances. However, remember that electric fields are greatly reduced in strength by objects like buildings, trees, and vehicles. Magnetic fields, on the other hand, are not blocked by most materials. Magnetic fields very close to electrical appliances are often stronger than the fields directly beneath power lines. However, appliance fields decrease in strength with distance more quickly than do power line fields.

The following tables show typical 60-Hz magnetic fields for a number of electrical appliances commonly found in homes and workplaces. Many people are surprised when they compare magnetic field measurement data from appliance to appliance and see that magnetic field strength does not depend on how large, complex, powerful, or noisy the

appliance is. In fact, the magnetic fields near large appliances are often weaker than those near smaller devices. There are many reasons why this can happen, all of them related to product function and design.

In the tables listed below, all magnetic field measurements are given in units of milligauss (mG), and dashes in columns mean that the magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

**To the Bathroom....**

**Kitchen....**

**Living/Family Room .....**

**Laundry Room....**

**Bedroom....**

**Electric Blanket....**

**Workshop....**

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## Federal Government Publications

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- *EMF in Your Environment: Magnetic Field Measurements of Everyday tl Electrical Devices*, U.S. Environmental Protection Agency (EPA), 1992. 32 pp. Available free from the U.S. EPA Public Information Center, 401 M Street, SW, Washington, DC 20460.

Designed for the general public, this booklet focuses on appliances as EMF sources. Includes tables showing magnetic field strengths at varying distances from 38 common electric appliances. Power lines and transportation sources are also discussed.

- *Electric and Magnetic Fields and the Potential Hazard to Human Health*, National Institute of Environmental Health Sciences (NIEHS), 1994. 6 pp. Available free: call 919-541-5085.

Fact sheet provides concise description of EMF research issues, highlighting work at NIEHS since 1988 and new interagency research effort.

- *Electric and Magnetic Fields (EMF) Research and Public Information Eg Dissemination (RAPID) Program: Research Agenda and Communication Plan*, EMF RAPID Program Interagency Committee, 1994. 10 pp. Available from U.S. Department of Energy: call 202-586-5575 (request publication no. DOE/ EE-0021). Also available from the National Institute of Environmental Health Sciences: call 919-541-5085.

Describes agenda for 5-year national research and risk assessment program on EMF.

National Institute for Occupational Safety and Health (NIOSH): 1-800-356 4674.

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## Public Information from Nonfederal Sources

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- *Answers to Frequently Asked Questions about Electric and Magnetic Fields (EMFs) Produced by 60-Hertz (Hz) Electric Power*, Massachusetts Department of Public Health, 1993. Available free: call 617-727-7170.

Public information fact sheet gives basic, consumer-oriented information on EMF health effects issue.

- *Electric and Magnetic Field Fundamentals: An EMF Health Effects Research Paper*, Electric Power Research Institute (EPRI), March 1994. Available from EPRI. Call 510-934-4212; request publication no. BR-103745.
- *EPRI Resource Papers on EMF*, EPRI. Single free copies available to nonprofit, government, and educational organizations: call 510-934-4212.

Series of resource papers, geared to a technical audience, covering exposure assessment, epidemiology, and basic EMF fundamentals.

- *Electric and Magnetic Fields from 60 Hertz Electric Power: What Do We Know About Possible Health Risks?* 1989. 45 pp.
- *Measuring Power Frequency Fields*, 1992. 25 pp.
- *What Can We Conclude from Measurements of Power Frequency Fields?* 1993. 45 pp.

Dr. Granger Morgan and colleagues at Carnegie Mellon University produced the above three booklets on EMF to present technical information for a nontechnical audience. Available from Carnegie Mellon for \$5.50 each.

- *Your Guide to Understanding EMF*, 1993. 15 pp.

Colorful brochures give simple presentation of basic EMF issues. Spanish versions are available. Can be purchased from the Culver Company: call 800-428-5837.

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## EMF Periodicals

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- *Between the Lines*, Center for Energy Information, Augusta, Maine. Call 800-947-8765.
- *EMF Health & Safety Digest*, Minneapolis. Call 612-6234600.
- *EMF Health Report*, Information Ventures, Inc., Philadelphia. Call 215732-9083.
- *EMF News*, Washington, D.C. Call 202-508-5425.
- *Microwave News*, New York. Call 212-517-2800. Will provide a current list of gaussmeter manufacturers. Send \$1.00 to Microwave News, P.O. Box 1799, Grand Central Station, New York, NY 10163.

## Articles & Books About the EMF Controversy

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# Appendix

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## Purpose

The Electric and Magnetic Fields Research and Public Information Dissemination (EMF RAPID) Program, | established by Sect. 2118 of the Energy Policy Act of 1992, focuses on finding answers to these key questions: Does exposure to EMFs produced by the generation, | transmission, and use of electric energy pose a risk to human health? If so, how significant is the risk, who is at risk, and how can the risk be reduced?

Research conducted under the EMF RAPID Program covers a broad range of scientific disciplines and complements EMF research already under way in the United States and abroad. The program coordinates and focuses the federal EMF research effort and provides a central point from which to evaluate research results and interpret them for the public.

## Organization

The U.S. Department of Energy (DOE) administers the overall program and directs research on exposure | assessment and field management techniques. The National Institute of Environmental Health Sciences (NIEHS) directs the risk assessment and health effects research. The public information component of the program is the responsibility of both DOE and NIEHS.

An Interagency Committee representing nine federal agencies is responsible for developing the program agenda; establishing guidelines for interagency coordination; and monitoring, evaluating, and reporting program results. The Interagency Committee includes representatives from

- the U.S. Department of Energy,
- the National Institute of Environmental Health Sciences,
- the U.S. Environmental Protection Agency,
- the U.S. Department of Defense,
- the Occupational Safety and Health Administration,
- the National Institute of Standards and Technology,
- the U.S. Department of Transportation,
- the Rural Electrification Administration, and
- the Federal Energy Regulatory Commission.

The program receives guidance from the National EMF Advisory Committee, whose members come from diverse constituencies, including public advocacy groups, organized labor, state governments, academia, and industry. The National Academy of Sciences will



evaluate the research conducted under the EMF RAPID Program.

## **Health Effects Research**

Health effects research will receive most of the funding under the EMF RAPID Program, and the research findings will be used to assess risk and develop risk assessment models. Research will focus on effects suggested by previous studies, such as childhood leukemia, brain cancer, breast cancer, neurobehavioral effects, and certain adverse reproductive effects, and will cover a wide range of disciplines, including epidemiology, toxicology, basic biology, and physiology. DOE and NIEHS will work together to ensure common, controlled exposures in EMF studies, and quality control procedures will be instituted for all health effects experiments.

## **Exposure Assessment and Field Management Research**

Exposure assessment research is required for EMF risk assessment. Researchers will study various environments to try to determine what kinds of EMF exposures are typical in those settings. Source characterization will also provide information for assessing potential EMF exposures by studying how people are exposed to specific EMF sources.

Field management research and development will be supported at this stage. If it is determined that EMF exposure poses a risk to human health, the results of this research will provide decision makers with options for reducing risk.

## **Risk Assessment**

Hazard identification, risk assessment, and risk evaluation models will be developed under the direction of NIEHS to provide a framework for using the scientific and engineering results in deciding whether there is any risk to human health from exposure to EMF. During the development of these models, the public will be kept informed and asked to comment.

## **Public Information**

The EMF RAPID Program will provide a source of up-to-date information for the general public about various aspects of the EMF issue: possible human health effects, the types and extent of human exposure, technologies for measuring and characterizing fields, and methods for assessing and managing exposure. This booklet, the first public information product of the RAPID Program, is also available in Spanish.

To facilitate the collection and dissemination of technical information on EMF, NIEHS and DOE are establishing an EMF Biomedical Science and Engineering Information Clearinghouse. The clearinghouse and its databases will include all available information about federally and privately funded EMF research.

Public information materials will include brochures for various audiences (including some Spanish language materials), resource guides and information summaries for policy makers measurement manuals, news media briefing materials, and an EMF public information hotline. Both the EMF Interagency Committee and the National EMF Advisory Committee

will review public information materials developed under this program. The EMF RAPID Program is not intended to replace or duplicate existing public information networks but rather will take full advantage of these resources.

## Funding

The law requires that at least 50% of the total costs of the EMF RAPID Program be offset by contributions from nonfederal sources. The program has a total authorization of \$65 million over a 5-year period. Nonfederal contributions are solicited based on the annual federal appropriation.

Early nonfederal contributors to the EMF RAPID Program include member companies of the Edison Electric Institute, the National Rural Electric Cooperative Association, the American Public Power Association, the Electric Power Research Institute, and the National Electrical Manufacturers Association.

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